■ Receivers

Low Noise VHF Pre-Amp

Ron Graham VK4BRG provides all the information needed to build a very useful receive pre-amplifier covering from 135 to 150 MHz.*

This VHF pre-amplifier has 50 ohm input/output impedance, is designed to provide around 18 dB gain and, with suitable modifications to the tuned circuits, covers the complete VHF band. The standard units tune the 2 m amateur band and the VHF weather satellite band, that is 135 to 150 MHz.

Two tuned circuits and input diode protection precede the BF-981 dual gate MOSFET. A broad band 9:1 impedance ratio RF transformer is used to match the BF-981 drain to the 50 ohm output line. This output line is suitably decoupled in order that the unit may be powered with approximately 12 volts via the output coax feedline for masthead pre-amp applications.

The above configuration provides a low noise figure combined with a high dynamic range. Extremely high stage gain tends to compromise the above, is normally not needed, and may lead to instability.

The small size of the printed circuit board (25 x 40 mm) means that it may be accommodated inside a radio with poor sensitivity and thus improve that radio's performance. Its principal application, however, is as a mast head pre-amplifier. In this situation it should greatly improve the overall receive system performance. This is of particular interest where long runs of feedline must be employed. Placing a pre-amp of this type at the mast head, close to the antenna, largely overcomes the receive system degradation caused by feedline losses. In some installations cheaper feedline (eg RG-58 in lieu of RG-213) may be used and suitable system performance maintained.

For mast head applications, the printed circuit board will fit into a 50 x 30 x 38 mm die cast metal box and, with BNC co-ax connectors fitted at each end, a neat and rugged unit results. It is recommended that, for continual exposure to the weather, this pre-amp assembly be further enclosed or covered with a plastic box. A suitable size box may be obtained from kitchenware suppliers. Exposure to sunlight will eventually degrade the plastic and it should be checked after 12 to 18 months. Alternatively, the pre-amp may be incorporated in a suitable enclosure that is normally used for the feedline/antenna termination. Electrical conduit junction boxes are recommended for this application.

Construction

All components are fitted to the ground plane (top) of the PCB. Firstly, fit components which have one lead soldered to both the top and bottom of the PCB, that is C1, C2 (rounded end to earth), D1, D2, C4, R3, R1, C3, C5, C7 and C6. You will thus have the required access for soldering to the ground plane.

Wind RFC, three turns passed through the toroid of 0.2 mm wire. Wind L2, six turns of 0.2 mm wire close wound in an anti clockwise direction on a four mm drill.

Wind L1 in two sections. Firstly, five turns as above. This section fits the two PCB holes either side of L1 as shown on the parts placement diagram. The one turn is actually about 7/8 of a turn and fits between the remaining two PCB holes.

Fit the RFC, L1 and L2 at this stage. The earthy ends of L1 and L2 are soldered to both sides of the PCB. The bottoms of the coils are spaced about one mm above the PCB, their axes parallel and a spacing of about two mm gives the desired amount of coupling.

Wind T1. Three pieces of 0.2 mm wire, 75 mm long, are twisted together at about three twists per 10 mm (not critical). Wind five turns through the toroid and space the winding over almost the complete circumference of the core. You will need an ohm meter to sort out the windings as per the schematic. Arrange the lead out positions so that they will fit the PCB. This takes a bit of thought! The joint that doesn't terminate on the PCB is simply tucked up the side of the winding out of harm's way.

Fit T1, C8 and TR1. The long lead of TR1 is the drain, so, with the device markings uppermost, the long lead faces the output end of the PCB. At this stage it would be wise to check your work.

Testing

For the DC test, apply approx 12 V DC to the output connector PCB pad via a milli-amp meter. Current should be about 10 mA. If not, investigate!

Specifications

Gain	18 dB approx
Tuning Range	135 — 150 MHz (standard)
Noise Figure	<1 dB
Input Impedance	50 ohms (unbalanced)
Output Impedance	50 ohms (unbalanced)
Operating Voltage	10 — 15 volts
Current Consumption	10 mA (at 12 volts)
Circuit Board Size	25 x 50 mm
Height	12 mm

Note: Supply voltage is fed via the RF output line for mast head pre-amp applications. By simply removing the RF choke the supply may be applied directly to the PC board.

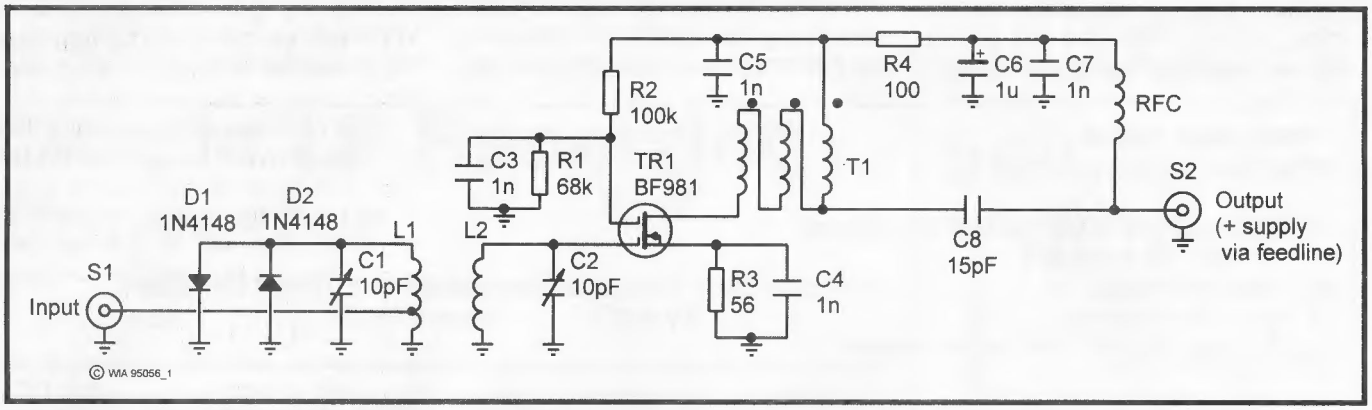

Fig 1 — Circuit of the VHF pre-amp.
RFC 3 turns 0.2 mm wire, FB43101 bead
L1 5 + 1 turns 0.4 mm wire, 4 mm diameter
L2 6 turns 0.4 mm wire, 4 mm diameter
T1 5 + 5 + 5 turns 0.2 mm wire, T25-12 core

For the RF test and alignment, temporarily attach suitable co-ax connectors to the input and output pads and ground, either via short pigtails or small diameter co-ax. If you have a suitable signal generator it is a simple matter of feeding that into the preamp and having the output of the preamp feeding a suitable receiver. The other alternative is to use signals off air.

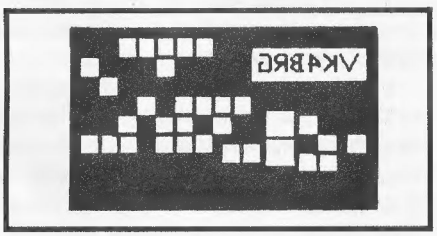

Fig 2 — Full size copy of the etching pattern for the ground plane side (top) of the circuit board.

Note that you may have to disconnect the preamp RFC and connect a separate 12 volt line to it if your test receiver doesn't feed the supply via the feedline. Using as weak a signal into the preamp as is possible to work with, adjust the trimmers for maximum preamp gain. It will be necessary to back off the input signal level as the trimmers are peaked. There is considerable interaction between the pairs of input and output trimmers so spend some time trying various combinations of adjustments to achieve the best result. The final small adjustments should be made to achieve the maximum quietening on an FM receiver with a weak signal source. Note that, with the preamp sitting unshielded on the work bench, it may pick up signals directly. Make sure that whatever input signal source you are using is being received via the input socket. Prove this by disconnecting the input signal.

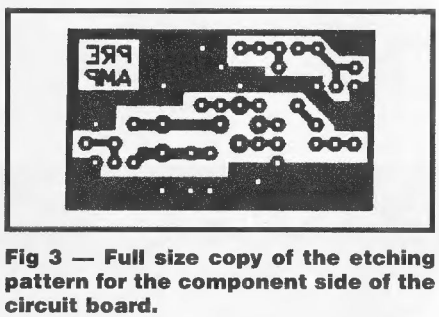

Fig 3 — Full size copy of the etching pattern for the component side of the circuit board.

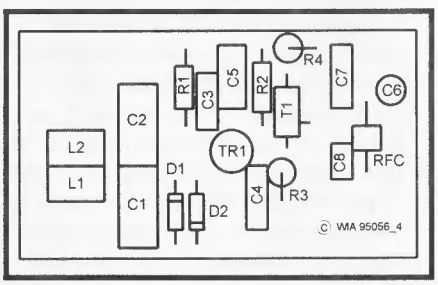

Fig 4 — Enlarged, not-to-scale component layout for the VHF pre-amp circuit board.

Final Notes

It is strongly recommended that the correct operation of the pre-amp be verified prior to mounting it in an enclosure, after which the trimmers may need a final adjustment.

One realises that most modern miniature designs for home construction call for:—

1. a specific PCB and that, even though a PCB pattern is supplied, a lot of potential constructors are not in a position to make the board; and
2. specific components with lead pitches to suit the PCB.

With the above in mind, and to assist potential constructors, I am trying to organise the supply, essentially at cost of PCB and parts

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kits; and built, tested and aligned units. Send a SASE to me at the address below for more details.

Also in the pipeline are articles describing the details for mounting the pre-amp into a small die cast box, and an active turnstile antenna for VHF weather satellite reception using the pre-amp.

Parts Schedule

Qty	Description	Lead Spacing	Notes
1	PCB Special double sided 40 x 25 mm		
1	BF-981 DG MOSFET		
2	1N4148 diodes		Use BAW62, BA482 if available
2	3 — 11 pF trimmer	5.0 mm	Murata (white)
1	56 ohm 1/4 watt 5% carbon resistor		
1	100 " " " "		
1	68 k " " " "		
1	100 k " " " "		
1	15 pF NPO ceramic capacitor	2.5 mm	Philips 680 series
4	1 n Hi K " "	5.0 mm	Philips 629 series
1	1 μf 35 V tantalum "	.5 mm	
1	FB43101 ferrite bead		Amidon
1	T25-12 toroidal core		Amidon
300 mm	0.2 mm diameter enamel wire		
300 mm	0.4 mm " " "		

*PO Box 323, Sarina QLD 4737